

TAXONOMIC NOTES ON THE CHRYSOTHAMNUS
VISCIDIFLORUS COMPLEX (ASTEREAEE, COMPOSITAE)

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The genus *Chrysothamnus*, consisting of about 13 species, ranges over most of western North America. These shrubs, commonly called rabbit-brush, are related to section *Macronema* or section *Ericameria* of *Haplopappus* and more distantly to *Solidago*. For the past several years I have been studying the genus *Chrysothamnus*. New names and notes in the *C. viscidiflorus* complex are presented here to enable their use in future publications on the anatomy and cytology of the genus. In addition to my 550 collections of *Chrysothamnus* and observations in the field and herbarium, I have utilized experimental gardens and greenhouse space at Logan, Utah (elevation 4850 ft) and Claremont, California (elevation 1350 ft) in this study.¹

Selected features of the inflorescence were studied in at least three collections of each of the eight subspecies of *C. viscidiflorus* and in the related species discussed below. Averages for these features for some of the taxa grown in the gardens are presented in Table 1 to illustrate variation produced in different environments. Variation in these features can also be seasonal; i.e., samples taken early in the flowering season frequently average more flowers per head than do samples from the same plant taken late in the season. Measurements from young flowers (pre-anthesis) could introduce error, since stigmatoid tissues mature later than style appendages. Heads of dried materials were selected for relative maturity, then softened several days in 50% ethyl alcohol to restore original size and for handling ease. For features of the involucre, 10 heads from each sample were studied; one flower from each head was used for floral measurements.

In some instances involucre length, bract number, corolla length, and average flower number per head vary within a subspecies, but these features still have diagnostic value when used with other characteristics. The width-length ratio of the involucre and ratio of stigmatic appendage length to total style branch length appear to be reasonably constant (fig. 1). Blake (1940) questioned the value of stigmatic features as diagnostic criteria; however, his position may have been influenced by the relationship he proposed for *C. molestus*. He described this taxon as a variety of *C. viscidiflorus*, but since *C. molestus* is not a close relative of *C. viscidiflorus*, the style branches of the two species need not necessarily be similar.

Chrysothamnus molestus (Blake) L. C. Anderson, comb. nov. *C. viscidiflorus* var. *molestus* Blake, Jour. Wash. Acad. Sci. 30:368. 1940.

¹ Contribution no. 626, Department of Botany and Plant Pathology, Kansas Agr. Expt. Station, Manhattan, Botany serial no. 785.

Blake (1940) named this taxon as a variety of *C. viscidiflorus* (Hook.) Nutt. of section *Typici*, but compared it with *C. pulchellus* (Gray) Greene, *C. depressus* Nutt., and *C. vaseyi* (Gray) Greene, all of section *Pulchelli*, the section to which *C. molestus* properly belongs. The glandular achenes of this species are similar to those of *C. depressus* and *C. vaseyi*. Heads of *C. molestus* are longer than those of *C. viscidiflorus* (table 1) and contain 21–24 phyllaries and 5–7 flowers; whereas heads of the latter usually have 10–19 phyllaries and 2–5 flowers.

This species was previously known only from the San Francisco Mountains in Coconino Co., Arizona. The following collections extend the known range of this species in Coconino Co.: 16 air mi S of Grand Canyon Village, T28N, R2E, *Anderson 1839* (KSC); 1840 (KSC); National Tank, Hualapai Indian Reservation, *Darrow 3135* (ARIZ).

CHRYSOTHAMNUS VISCIDIFLORUS (Hook.) Nutt. ssp. planifolius L. C. Anderson, ssp. nov. Frutex e radice crassa caudiceque multiramoso lignoso. Caules plures, 1.2–2.5 dm alti, foliosi ad inflorescentiam, rigide erecti vel ascendentes, infra simplices, inflorescentiis ramosis, glabres. Folia (10) 14–20 mm longa, 1–2 mm lata, anguste lanceolata, cuspidata, plana, aliquanto crassa, integria. Capitula in inflorescentiam corymbosam planam vel convexam disposita; involucris (4) 5–5.6 mm altis, cylindricis; phyllariis 15–17, stramineis, apicibus leviter crassis; floribus 3–4(5); corollis flavis, 3.5–4.5 mm longis, dentibus, 1.4–1.7 mm longis; antheris 1–1.5 mm longis, apicibus attenuatis 0.3–0.4 longis; stylus ramis 1.4–1.7 mm longis, appendice lineis stigmaticis brevior; achaenis 3–3.5 mm longis, pubescentibus.

Type: Arizona, Coconino Co.: dry sandy soil of sparse juniper slopes (Cedar Ridge) at 5500 ft, 16.5 mi N of The Gap, 11.5 mi S of Bitter Springs, *Anderson 1747* (ARIZ, KSC, MSC, UC—holotype, US, UTC).

Additional specimens examined: Arizona, Coconino Co.: Box Canyon, Wupatki National Monument, *Jones 28* in 1939 (US); 1 mi E of The Gap, *Anderson 1851* (KSC); 4.5 mi N of The Gap, *Anderson 1852* (KSC); type locality, *Anderson 1749* (KSC); 11 mi N of Cedar Ridge Trading Post, *Darrow 2886* (ARIZ); 6 mi S of Bitter Springs, *Anderson 1853* (KSC); 1902 (KSC). *Kearney & Peebles 12813* (ARIZ, US), collected 20 mi W of Cameron, represents a geographically peripheral population with pubescent stems.

This subspecies is related to *C. viscidiflorus* ssp. *elegans* (Greene) Hall & Clem., from which it differs by having flat, thickened leaves, glabrate stems, and smaller heads. It is perhaps distantly related to *C. viscidiflorus* ssp. *stenophyllus* (Gray) Hall & Clem.; the two grow together at the type locality, but no intergradation has been observed. *Chrysothamnus viscidiflorus* ssp. *stenophyllus* differs by having narrower, twisted leaves and larger heads. Twisted leaves appear to be only modifications to the xeric environment as indicated by greenhouse studies; however, all subspecies, except *C. viscidiflorus* ssp. *planifolius*, have twisted leaves to some degree in native habitats.

CHRYSOTHAMNUS VISCIDIFLORUS ssp. HUMILIS (Greene) Hall & Clem. Keck (Munz, 1959) reduced this subspecies to synonymy under

TABLE 1. DATA FOR SELECTED FEATURES OF INVOLUCRE AND FLOWER

Taxon	Collection Original locality Garden progeny	bract number	involucral length, mm	involucral width-length, %	corolla number	corolla length, mm	corolla lobe length- total length, %	style branch length, mm	style appendage-total branch length, %
<i>C. molestus</i>	Anderson 1840 (KSC) Coconino Co., Ariz.	22.0	11.1	23.4	5.2	8.1	12.7	3.2	37.7
	Claremont garden	23.3	10.9	25.4	7.3	7.1	16.1	2.9	45.1
<i>C. limifolius</i>	Anderson 1487 (KSC) Grand Co., Utah	13.2	4.5	49.3	5.2	4.9	26.1	1.7	41.7
	Logan garden	14.9	5.7	43.6	5.4	5.1	29.9	1.5	41.7
	Anderson 1860 (KSC) Kane Co., Utah	12.3	5.5	46.3	5.2	6.0	37.5	2.1	47.9
	Claremont garden	13.3	5.2	42.3	5.2	5.1	42.5	2.0	47.4
<i>C. viscidiflorus</i> ssp. <i>elegans</i>	Anderson 1926 (KSC) Juab Co., Utah	14.6	6.9	29.5	4.1	5.3	29.5	2.5	31.2
	Claremont garden	13.4	5.9	35.4	4.6	4.7	27.3	2.2	33.0
<i>C. viscidiflorus</i> ssp. <i>humilis</i>	Anderson 1617 (KSC) Modoc Co., Calif.	14.8	9.7	22.2	2.3	7.5	19.2	3.1	53.1
	Claremont in 1961	11.8	8.2	25.7	3.2	6.8	17.8	3.3	52.3
	Claremont in 1962	11.5	9.6	22.7	3.3	7.3	17.2	2.7	51.4
<i>C. viscidiflorus</i> ssp. <i>planifolius</i>	Anderson 1747 (KSC) Coconino Co., Ariz.	15.2	5.5	31.5	3.9	4.3	37.8	1.5	29.1
	Logan garden	15.4	5.0	35.1	4.7	3.8	38.3	1.8	29.1
<i>C. viscidiflorus</i> ssp. <i>pumilus</i>	Anderson 885 (KSC) Iron Co., Utah	14.9	5.9	27.8	3.5	4.3	25.2	2.5	27.7
	Logan garden	13.7	6.2	28.0	3.9	5.0	31.9	3.1	27.8
<i>C. viscidiflorus</i> ssp. <i>stenophyllus</i>	Anderson 1695 (KSC) Coconino Co., Ariz.	15.2	6.5	25.1	3.5	5.1	28.3	2.2	42.2
	Claremont garden	15.0	6.1	27.5	3.9	5.0	36.0	2.6	36.6
	Logan garden	12.2	6.5	25.8	3.6	5.1	32.7	2.4	38.6
<i>C. viscidiflorus</i> ssp. <i>viscidiflorus</i>	Anderson 1701 (KSC) Coconino Co., Ariz.	16.3	7.4	29.7	4.5	6.2	28.3	2.9	29.4
	Claremont garden	14.4	7.3	31.9	5.0	6.1	30.9	2.5	29.2
	Logan garden	17.6	9.9	22.7	4.0	6.3	26.2	2.9	33.0

C. viscidiflorus ssp. *puberulus* (D. C. Eat.) Hall & Clem. Intergradation between the two taxa where their ranges overlap is indicative of their infraspecific relationship; nonetheless, farther north *C. viscidiflorus* ssp. *humilis* is one of the most distinctive units in *C. viscidiflorus*. Such distinguishing features as the long, narrow involucre, few flowers per head, style branches included or barely surpassing the corolla lobes (fig. 2), and long stigmatic appendages (the five circles to the right in fig. 1 rep-

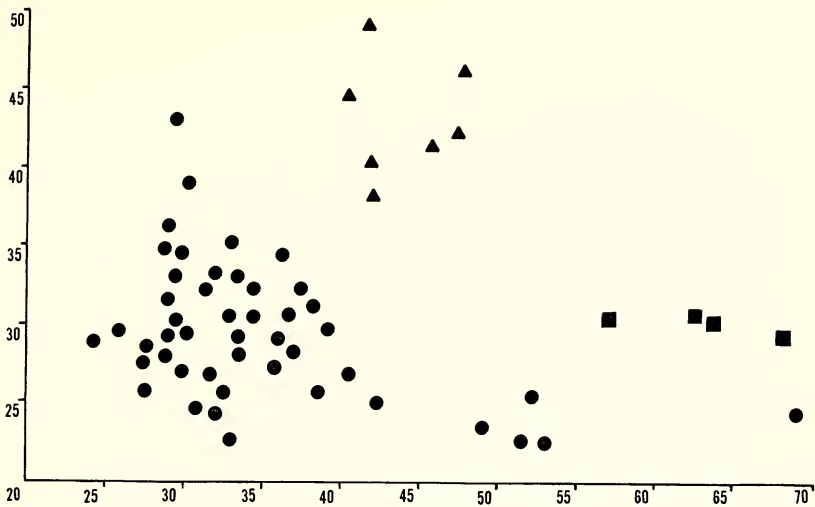


FIG. 1. Scatter diagram for selected floral features expressed in percentages. Horizontal axis is the ratio of style appendage to total style branch length; vertical axis is the width-length ratio of the involucre. Circles represent *C. viscidiflorus*; triangles *C. linifolius*; and squares *C. spathulatus*.

resent this subspecies) were maintained when the plants were grown in experimental gardens (table 1).

CHRYSOTHAMNUS AXILLARIS Keck. Populations from Inyo County, California, and adjacent Nevada for which this name has been provided (Keck, 1958) do not appear to be sufficiently distinct from *C. viscidiflorus* to justify taxonomic recognition with the evidence at hand. These plants represent forms of *C. viscidiflorus* ssp. *stenophyllus* having involucre bracts with attenuate tips arranged in very pronounced vertical ranks. *Anderson 1480* (KSC) and *1483* (KSC) from Emery and Grand Co., Utah, respectively, are collections of this subspecies with similar involucre features.

The following are collections with similar bract alignment that are referable to other subspecies: to *C. viscidiflorus* ssp. *viscidiflorus*: Inyo Co., California, *Anderson 2000* (KSC); *Anderson 2004* (KSC); *2007* (KSC); Coconino Co., Arizona, *Anderson, 1881*: to *C. viscidiflorus* ssp. *elegans*(?): Mono Co., California, *Anderson 2015* (KSC); to *C. viscidiflorus* ssp. *puberulus*: Inyo Co., California, *Anderson 2014* (KSC); Riverside Co., California, *Anderson 1933* (KSC); *1935* (KSC); *1936* (KSC), bracts also acuminate.

The geographically isolated population from Riverside Co., California, is very different from other populations of *C. viscidiflorus* ssp. *puberulus* by having broader leaves, heads congested in the inflorescences, and 17-21 phyllaries per head (an unusually high number for *C. viscidiflorus*). The disposition of this population cannot be determined until additional data are available.

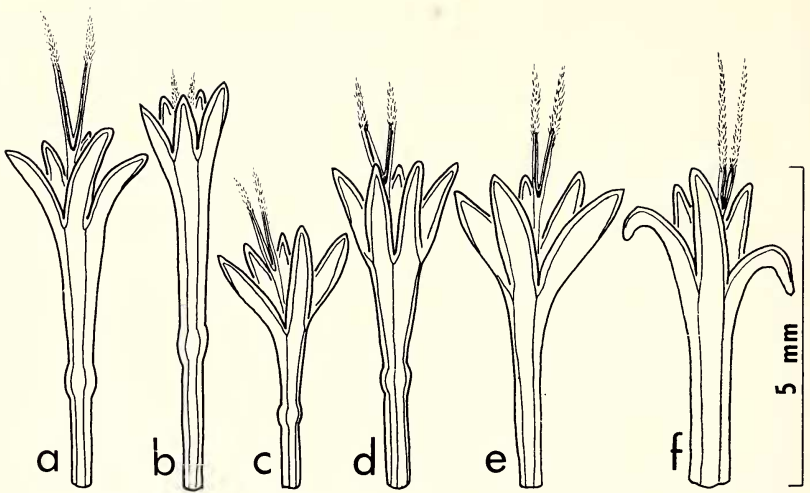


FIG. 2. Line drawings of flowers with stamens removed; a, *C. viscidiflorus* ssp. *viscidiflorus* (Anderson 1701, KSC); b, *C. viscidiflorus* ssp. *humilis* (Anderson 1617, KSC); c, *C. viscidiflorus* ssp. *planifolius* (Anderson 1747, KSC); d, *C. viscidiflorus* ssp. *stenophyllus* (Ferris 6924, POM, isotype of *C. axillaris*); e, *C. limifolius* (Anderson 1860, KSC); f, *C. spathulatus* (Anderson 2052, KSC).

CHRYSOTHAMNUS LIMIFOLIUS Greene. Hall (Hall and Clements, 1923) treated this taxon as a subspecies of *C. viscidiflorus*; however, I recognize it as a separate species. In addition to differences in plant form and habitual preference pointed out by Hall, *C. limifolius* has these distinguishing features: 1) heads are slightly turbinate rather than narrowly cylindrical, are much wider in relation to their length (fig. 1), and have more flowers than *C. viscidiflorus*; 2) the point of staminal departure from the corolla tube is not readily apparent externally (fig. 2); whereas in *C. viscidiflorus* the tube is somewhat swollen at this point and often darkly colored; 3) the bases of the style branches are free; they are frequently fused for 0.5–1 mm in *C. viscidiflorus*; 4) the style appendages are longer than those of *C. viscidiflorus*, excepting the unique *C. viscidiflorus* ssp. *humilis*; 5) the plants have lateral roots from which adventitious shoots arise as far as 4 dm from the main axis of the plant; in this respect *C. limifolius* differs from all other species in the genus. Even though plants of this species usually grow in sandy soil, they are soboliferous when grown in experimental plots of very fine clay loam.

***Chrysothamnus spathulatus* L. C. Anderson, sp. nov.** Frutex e radicibus multiramis lignosis. Caules plures, 7–15 dm alti, foliosi ad inflorescentiam, puberulentes. Folia 3.5–4.7 cm longa, 5–10 mm lata, ad inflorescentiam parviora, spathulata, apicibus rotundatis apiculatisque, plana, subtile puberulenta. Capitula in inflorescentiam corymbosam plus

minusve planam disposita; involucris 6.3–7.5 (8.5) mm altis, cylindricis; phyllariis 13–16, stramineis, apicibus pallide viridibus; floribus 3–4 (5); corollis flavis, 4.6–5.4 mm longis, dentibus, 1.7–2.6 (3.0) mm longis; antheris 2.1–2.3 mm longis, appendicibus 0.5 mm longis; stylus ramis 2.2–3 mm longis, appendice lineis stigmaticis longiore; achaenis 2.5–3 mm longis, sparse pubescentibus, pilis 0.1–0.25 mm longis, raro glabris. Cotyledones 7 mm longae, 3 mm latae, spatulatae.

Type: New Mexico, Otero Co.: shaded loamy soil in Pinyon-Juniper-Oak Association on the "Upper Burro Flats" at 6000 ft between LaLuz and LaBorcita canyons, 7 mi NE by road from town of LaLuz, T15S, R10E, Sec 14 and 15, *Anderson 2052* (KSC, MSC, NMC, UC—holotype, US, UTC). The type collection was propagated at Claremont, California, as transplants taken from the type locality; *Anderson 1905* (KSC) represents immature specimens from the type locality.

Additional specimens examined: New Mexico, Otero Co.: Sacramento Mountains, *Rehder 331* (US); *332* (US); High Rolls, *Vaughn 2155* (ARIZ); NW of High Rolls, *Jackson 8083* (NMC). Socorro Co.: Mt. Oscuro at 6000–7000 ft, *Dunn & Lint 4030* (NMC).

This species, isolated by 150 mi from its near relatives, is distinct by having spatulate cotyledons (found in no other *Chrysothamnus*), spatulate to oblanceolate leaves, long style appendages, achenes with few, very short hairs, and unlike other members of the *C. viscidiflorus* alliance, the broken twigs emit a fragrance similar to that of *C. nauseosus*. The species can be further distinguished from *C. viscidiflorus* (of which ssp. *lanceolatus* probably is the nearest relative) by its height, free style branches with long appendages, and lack of swelling at the point of staminal departure from the broader corolla tube (fig. 2).

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DAVID DOUGLAS AND THE DIGGER PINE: SOME QUESTIONS

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While collecting in the central coast region of California in 1831, David Douglas described *Pinus sabiniana* Dougl. in a letter written at Mission San Juan Bautista (Douglas, 1833). Descriptive passages in this letter—and sketches later made from the specimens—leave no doubt that Douglas had studied *P. sabiniana* cones, seed, and foliage at San Juan